SUBJECT INDEX

A

Acoustic streaming
  and vortex energy separation, 47–48
Aerodynamische Versuchsanstalt (AVA)
  and Ludwig Prandtl, 7–8, 14–18
Airfoil problems
  and shock computation, 327, 328–29
Algebraic Stress Model (ASM)
  and rapid-distortion theory, 550
Archimedean buoyancy
  and magnetic fluids, 447

B

Baroclinic eddy, 505
Baroclinic flow
  and isolated eddy models, 522
  and a two-layer stationary modon, 519–21
Barotropic flow
  and isolated eddy models, 501–2
Barotropic modon
  and isolated eddy models, 505
Barotropic Rossby waves
  and isolated eddy models, 510
Beltrami equation
  and supercell propagation, 392–93
Bénard convection
  and spectral methods, 361
  and thermocapillary instabilities, 411, 415–15, 418
Bénard instability limit, 412
Bernoulli equation
  and magnetic fluids, 444–45, 450
Bessel function(s)
  and isolated eddy models, 517
  and thermocapillary instabilities, 415
Bifurcation
  and critical points, 137, 139, 148
  subcritical
    and viscous fingering, 286
Bifurcation lines
  in flow patterns, 133
Bifurcation theory
  and thermocapillary instabilities, 412–16, 418, 428–29
Biot-Savart law, 145
Bjerknes attraction force
  and cavitation bubble experimentation, 113–14
Bjerknes boundary-interaction term, 106
Bjerknes effect
  and cavitation bubbles, 117
Bore(s)
  limiting
    and upstream blocking, 82, 84
  upstream, 83
Boundary layer(s)
  and spectral methods, 346, 351–53, 355, 357–60
  three-dimensional, 56–61
Boundary-layer techniques
  and entry flows, 158–59
Boussinesq approximation
  and thermocapillary instabilities, 406
Boussinesq equations
  and tornadic thunderstorms, 373
Boussinesq primitive equations
  and eddy models, 508
Boussinesq system
  and tsunamis, 220, 228–29
Bray-Moss-Libby model
  and turbulent premixed flames, 253, 259–61, 266
Brownian motion
  and solute transport, 190, 203
Brownian motion component
  and solute transport, 191, 193–94, 201, 210
Brownian relaxation mechanism, 440
Brownian rotation
  and magnetic fluids, 459
Brownian rotational diffusion time
  and ferrofluid, 439–40
Brownian rotational relaxation time, 442
Brunt-Väisälä frequency, 495
Bubble-cloud phenomenon, 121
Bubble-generation techniques
  in cavitation experiments, 102–4
Bubbles
  cavitation
    near boundaries, 99–122
Buckley-Leverett equations
  and viscous fingering, 306, 308
Buckley-Leverett theory
  and viscous fingering, 305–6
Buoyancy
  and magnetic fluids, 446–47
Buoyancy effects
  and cavitation bubbles, 103, 115–17
Buoyancy force(s)
  and cavitation bubbles, 113–14, 117

C

Capillary rheometer, 158–59, 164
Carrean number
  and entry flows, 163–68
Cauchy-Poisson problem
  and tsunamis, 223–24
Cavitation bubbles, 99–122
  and buoyancy effects, 103
  computer simulation of, 121–22
  experimentation techniques, 102–4
  and free surface, 115–18
  and the Kelvin impulse, 105–8, 113, 115, 119
  near a flexible boundary, 117–20
  near a rigid boundary, 110–15
  near deformable surfaces, 119–22
  and numerical calculations, 108–10, 121
  theoretical models of, 104–10
Chebyshev series
  and spectral methods, 341, 343–44
Chebyshev spectral approximations, 352
Chebyshev spectral collocation method, 342–43, 352–53
Chebyshev spectral method(s), 344–46, 351, 355, 361–62
Chebyshev time-step limitation, 347
Chile
  a tsunami in, 233
CISK (Conditional Instability of the Second Kind)
  see Wave-CISK
Clear slot
  in a supercell thunderstorm, 396

Collocation
  spectral, 341
Collocation method(s)
  Chebyshev spectral, 342–43, 352–53
  Fourier, 353–54
Collocation points
  and spectral methods, 346, 352–53
Collocation technique
  and spectral methods, 340, 355
Combustion
  flame-sheet, 246, 251–57, 261–66
  flamelet, 254–55
  regimes of, 245–47
  swirl-stabilized, 32–35
  and turbulence
    in turbulent premixed flames, 259–66
  turbulent premixed, 238–39, 242–43
Computational methods
  and isolated eddy models, 527
Computer simulation
  of cavitation bubbles, 121
Conical meniscus
  and magnetic fluids, 445
Continuity equations
  and critical-point concepts, 125–27, 135, 149–50
Contractions
  viscoelastic flows through, 157–80
Convection
  axisymmetric
    and thermocapillary instabilities, 432–33
  Bénard
    and spectral methods, 361
    and thermocapillary instabilities, 411, 414–15, 418
  Marangoni, 405, 408, 411–12
    experiments, 416–17, 429, 431
    flow-induced, 421–23, 425, 429, 431
  meniscus
    and thermocapillary instabilities, 432–33
  and solute transport, 203, 205
  and thermocapillary instabilities, 413–15, 419
Convection-dispersion equation
  and solute transport, 192, 195
Convection velocity
  and eddying motions, 143–44
Convective instabilities
  linear flow, 420–24
  return flow, 424–26
Convective instability
  and magnetic instability, 455–56
Convective storm
  see Supercell thunderstorms
Coriolis effects
  and supercell thunderstorms, 381, 385
Coriolis force
  and isolated eddy models, 510, 513
  and supercell thunderstorms, 373, 379–80
Coriolis parameter
  and isolated eddy models, 495, 510
Couette correction
  for power-law fluids, 164–65
Couette flow
  and rapid-distortion theory, 537
Critical layers
  and upstream blocking, 76
Critical liquid-vapor point
  and finite perturbations, 587–97, 599
Critical point
  finite-amplitude waves near the, 579–87
  free-slip, 128–129, 134–35, 138–39
  no-slip, 128–29, 138, 150
  shock waves near the, 577–78
  sound waves near the, 579–81
Critical-point concepts
  and flow patterns and eddying motions, 125–53
Cumulus clouds
  and thunderstorms, 373–74
Cyclone separators, 41–43

D

Damköhler number
  and turbulent premixed flames, 245–47, 249, 251–53, 256–58
Darcy equations
  single-phase, 296, 302
Darcy's law, 275, 278, 288, 304
  and solute transport, 198
Deborah number, 177
  and elastic fluids, 169
Die swell, 168
Diffusion-limited aggregation (DLA)
  and viscous fingering, 284, 295, 298, 300, 307–8
Dipolar structures
  and isolated eddy models, 527
Dipole solutions
  and isolated eddy models, 501–8
Disks
  finite
    and Kármán swirling flows, 486–88
Dispersion
  hydrodynamic
    and solute transport, 184
  and solute transport, 202–3, 209
Dispersivity
  and solute transport, 184, 186–87, 201
Dissipation transport equation
  and rapid-distortion theory, 557–59
Distorted-structure model
  and rapid-distortion theory, 540–47
Draft-tube surge, 44–46
Drag reduction
  and magnetic fluids, 458
Ducts
  curved
    flow in, 68–69
  and shock computation, 327, 330–31
Dust separators
  cyclone, 41

E

Earthquakes
  and tsunamis, 217–18, 231–34
Eddies
  large
    and rapid-distortion theory, 534–36
  and rapid-distortion theory, 532–33, 540–47, 555–58, 564, 568
    three types of, 540–41
  roller
    and rapid-distortion theory, 535–36, 541–43, 545
Eddy
  large-eddy breakup devices (LEBUS), 540
  Large-Eddy Simulations (LES), 547, 558
Eddy models
  and integral relationships, 508–13
  isolated, 493–527
    far-field structure, 497–99
    general properties, 497–513
    and modons, 513–26
    point-vortex, 499–508
Eddy simulations
  and spectral methods, 360–61

Eddy structure
and rapid-distortion theory, 538, 545, 551, 564, 567
Eddy-viscosity models
and rapid-distortion theory, 549–56, 569
Eddying motions
using critical-point concepts, 125–53
Eigenfunction(s)
and Kármán swirling flows, 481, 485
and rapid-distortion theory, 535
Eigenvalues
and critical points, 129–31, 135–36
and spectral methods, 345, 347, 355
Eigenvector planes
and critical points, 129, 131–32
Eigenvectors
and critical points, 129–32, 136
Eikonal equation
and tsunami calculation, 227
Elasticity
and shear-thinning viscosity, 172–78
of viscoelastic fluids, 168–69
Ellis fluid
and entry flows, 166
Ellis number, 163–64
Energy conservation
global, 443, 454
Energy stability theory
and thermocapillary instabilities, 412
Engineering science
and German higher education, 2–3
Entrainment
and rapid-distortion theory, 534, 536, 540, 543
Ergodicity
and solute concentration variance, 205–9
Euler equation(s)
and critical points, 135, 138
and flow patterns, 133
and spectral methods, 350–51
and turbulent premixed flames, 259, 263
Euler solver
and shock computation, 322
Eulerian velocity field
and solute transport, 190–98, 203
Exponential convergence
in spectral methods, 341

F

Fanning function factor, 164
Fano effect, 168
Fast Fourier Transform (FFT), 344
Ferrofluid(s), 437–61
magnetization of, 438–42
Ferrohydrodynamic equations, 442–43
Ferrohydrodynamics (FHD) 437, 460
a problem in, 444
quasi-equilibrium, 440–41
Ferrohydrostatic bearing
and magnetic fluids, 447
Ferrohydrostatic response
of a ferrofluid to a current, 445
Ferrohydrostatics, 440–41
Finite-element code
and entry flows, 168, 177
Fjortoft restriction
and modon stability, 526
Five-spot experiments
and viscous fingering, 297, 299
Five-spot pattern
and viscous fingering, 274, 282, 294, 300, 308
Flame(s)
double-kernel, 238
laminar, 242–43
governing equations, 239–41
stable
in combustors, 32, 35
turbulent premixed, 237–67
and combustion and turbulence, 259–66
flame-sheet combustion, 251–57
flame-sheet regime, 246–53, 258, 267
governing equations, 239–41
structure, 245–59
Flame-sheet combustion, 251–57, 261–66
Flame-sheet regime
and turbulent premixed flames, 246–53, 258, 267
Flame stabilization
in combustion chambers, 27
Flow
obstacle
and supercell thunderstorm propagation, 387–88
Flow instabilities
and magnetic fluids, 451–56
Flow machinery
confined vortices in, 27–49
Flow patterns
using critical-point concepts, 125–53
Flow stabilization
and magnetic fluids, 456–58
Flows
equilibrium
and magnetic fluids, 443–51
junction, 65–67
reacting
and spectral methods, 361–62
secondary
skew-induced, 56–64
stress-induced, 70–71
with shocks, 313–35
turbulent secondary, 53–72
von Kármán swirling, 465–88
vortex, 64–69
Fluid dynamics
spectral methods in, 339–62
Fourier coefficients
and rapid-distortion theory, 537
Fourier collocation approximations
and spectral methods, 354
Fourier collocation methods, 353
Fourier expansions, 361
Fourier methods
and isolated eddy models, 527
Fourier series
and rapid-distortion theory, 533
and shock computation, 315
and spectral methods, 341, 343
Fourier spectral methods, 345–46, 350, 353–54, 360–61
Fourier transform
and solute transport, 191, 193–94, 198, 201
Fourier transform space
and solute transport, 190, 203
Froude number
and upstream blocking, 77–78, 88

G

Galerkin approximations, 354
Gaussian process
and solute transport, 192
Geophysics
isolated eddy models in, 493–527
Gesellschaft für Angewandte Mathematik und Mechanik (GAMM), 8–10

Gibbs phenomenon
and shock computation, 315, 325
and spectral methods, 350–51
Göttingen University, 3–4
Ludwig Prandtl at, 4–7
Gravity
and viscous fingering, 275–76, 281, 288, 290
Green's formulas
and shock computation, 313
Green's function(s)
and eddy models, 500
and solute transport, 197–98, 200
Groundwater
and solute transport, 183–214
Gulf Stream rings, 522, 524
Gust front
of supercell thunderstorms, 371, 381, 386, 389, 395, 398

H

"Hairy sphere" theorem
of fluid flow, 127
Hele-Shaw cell(s), 271
immiscible displacements in, 279–88
miscible displacements in, 288–96
and porous media flows, 296–98
Hele-Shaw-Chouke theory
and viscous fingering, 303–4, 306–7
Hele-Shaw equations, 279–80, 282, 284–87, 294
Hele-Shaw flows
and viscous fingering, 277–96
simplification of, 277–79
Hele-Shaw theory
and viscous fingering, 305–6
Helicity
and supercell thunderstorm propagation, 392–93
Helmholtz equations
and spectral methods, 357
Hetons
and isolated eddy models, 504–5
Holography
and bubble-boundary interaction experiments, 102
Hydraulic drop
and upstream blocking, 87
Hydraulic jump
in multilayer systems, 86
in a single-layer flow, 78–80
in a two-layer flow, 82–83, 87
Hydrocyclones, 41, 43
Hydrodynamic bearings
and magnetic fluids, 449–51
Hydrodynamic dispersion
and solute transport, 184
Hydrodynamic entrance-region problem, 158
Hydrostatic bearings
and magnetic fluids, 446–47
Hydrostatic flow
of a single layer, 78
Hydrothermal instabilities, 418–30, 431
basic state, 418–20
nonlinear theory, 428–29
Hysteresis
and magnetic fluids, 452–53
and thermocapillary instabilities, 413, 416
and upstream blocking, 80, 83

I

Implosion mechanism
of cavitation, 100–11
Rayleigh, 104, 108, 121
Inertia
fluid
and entry flows, 160–62, 164, 166–67, 170
Infinite-order accuracy
in spectral methods, 341
Instabilities
convective
and linear flow, 420–24
return flow, 424–26
hydrothermal, 418–31
surface-wave, 429–32
linear flow, 426–27
return flow, 427–28
thermocapillary, 403–33
Instability
convective
and magnetic fluids, 455–56
labyrinthine
and magnetic fluids, 454–55
Marangoni, 407–18
flow-induced, 422–23, 429
normal-field
and magnetic fluids, 451–54
Saffman-Taylor, 276–77
Integral relationships
and isolated eddy models, 508–13
Inviscid flow
and spectral methods, 349–51
Inviscid solutions
and Kármán swirling flows, 468–72, 475–76, 478, 481–85
Iterative methods
and spectral methods, 347, 349, 362
Iterative procedure
and critical points, 149
Iterative scheme(s)
and solute transport, 193–95
and spectral methods, 352
Iterative techniques
and spectral methods, 357, 360

J

Jets
in cross-flow, 69–70
eddying motions in, 140–48
fluid flow in, 135
nonmoving critical points in, 139
Jupiter's Great Red Spot, 465, 493, 501, 522

K

Kaiser-Wilhelm-Institut (KWI)
and Ludwig Prandtl, 7–8, 10–18
Kamchatka tsunami, 226
Kármán street
and shock computation, 330
Kármán swirling flows, 465–88
and finite disks, 486–88
and inviscid solutions, 468–72, 475–76, 478, 481–85
nonstationary flows and stability, 487–88
and the one-disk problem, 466–68, 470–79, 484–88
and the two-disk problem, 466–68, 470, 476, 479–88
Kelvin-Helmholtz billows, 87
Kelvin impulse
and cavitation bubbles, 105–8, 113, 115, 119
Kleiser-Schumann influence-matrix technique, 360
Korteweg-deVries (KdV) equation
and tsunamis, 220–21, 227
and upstream blocking, 83–85, 88
Korteweg-deVries soliton
of geophysical flows, 494
Kummer's equation
and Kármán swirling flows, 470

L

Labyrinthine instability
and magnetic fluids, 454–55

λ-scheme
and shock computation, 321–22, 324–28, 330, 333–35
Laplace equation
and solute transport, 198
and spectral methods, 349
and viscous fingering, 284, 298
Laplace relation
and thermocapillary instabilities, 403
Large-Eddy Simulations (LES), 547, 558
Lasmos
and rapid-distortion theory, 540–44, 555, 569
Leap Frog
in spectral methods, 345–46
Legendre transformation
and tsunamis, 230
Levitation
and magnetic fluids, 446–47
Lewis number
and laminar flame studies, 240
in a turbulent flame sheet, 253
and turbulent flames, 240, 242, 245

M

Mach number
and shock computation, 322–24, 330, 333
and spectral methods, 350, 361–62
Mach-number assumption
and laminar or turbulent premixed flames, 240
Mach reflection(s), 328
complex, 327, 331–33
Macrodispersion
and solute transport, 205
Macrodispersivity
and solute transport, 200
Magnetic fluids, 437–61
behavior, 437–43
and buoyancy, 446–47
and the conical meniscus, 445
constitutive equations, 442–43
and continuum equations, 440–42
and convective instability, 455–56
and drag reduction, 458
equilibrium flows, 443–51
and flow instabilities, 451–56
and flow stabilization, 456–58
and hydrodynamic bearings, 449–51
and hydrostatic bearings, 446–47
and impactless printing, 451
and labyrinthine instabilty, 454–55
and levitation, 446–47
and magnetic relaxation, 439–42
and rotary-shaft seals, 445–46
and sink-float separation, 448–49
and the tangential-field mechanism, 456–57
and two-phase flow, 460–61
Magnetic moment
and ferrofluids, 442
rotation of, 439
Magnetization
of ferrofluid, 438–39
and magnetic relaxation, 439–42
Magnus effect
and supercell thunderstorms, 388
Marangoni convection, 405, 408, 411–12
experiments, 416–17, 429, 431
flow-induced, 421–23, 425, 429, 431
Marangoni instability, 407–18
flow-induced, 422–23, 429
physical mechanisms, 411–12
Marangoni number
and thermocapillary instabilities, 407
Mathematical descriptions
of tsunamis, 218
Maxwell fluid, 169
Maxwell model
of entry flows, 171–72, 174
Maxwell relaxation time, 172–73
Megadispersion
and groundwater solute transport, 184
Melt fracture, 168, 170
Modon eddy models, 494, 527
Modons
exact solutions of, 513–21
and isolated eddy models, 499, 502, 513–26
radiating
and isolated eddy models, 521–24
stability of
and isolated eddy models, 524–27
Monopolar solutions
and isolated eddy models, 501
Monotonicity
and shock computation, 320–21
Motion
equations of
and shock computation, 314–15, 324

N

Navier-Stokes equations
and critical-point concepts, 125–27, 134–35, 138, 149–50
and Kármán swirling flows, 465–66, 488
and thermocapillary instabilities, 406
Navier-Stokes flow
and spectral methods, 353–61
Navier-Stokes one-dimensional equation
and rarefaction waves, 583
Navier-Stokes Simulations, Full (FNS), 547, 558
Néel mechanism, 439–40
Néel relaxation, 440, 442
Newtonian fluid(s)
and entry flows, 159–62
equations of motion for, 159
and thermocapillary instabilities, 405
and viscoelastic fluid, 168
in viscosity experiments, 271, 295–96
viscosity of, 158
Non-Newtonian fluid(s)
and entry flows, 158–59
inelastic
and entry flows, 162–68
and rapid-distortion theory, 550
in viscosity experiments, 271, 295
Northern Hemisphere
Coriolis force in the, 379
Numerical calculations
spectral methods in, 341
Numerical model(s)
of tsunami behavior, 230–31
and tsunami calculation, 226–29
Numerical simulation techniques
and entry flows, 174–75
Numerical solutions
and cavitation bubbles, 104–5, 108–10, 121
in Kármán swirling flows, 474–79, 482–84
Numerical thunderstorm simulations, 372, 374, 376–77, 379–85, 388–90, 393–96

O

Occlusion
  and tornadic thunderstorms, 394–95
Oldroyd B fluid, 169
Oldroyd B model
  of entry flows, 171–72, 174
Open-channel siphon
  as a flow phenomenon, 168
Orr-Sommerfeld equation, 355
  at high Reynolds number, 285, 306

P

Pacific Ocean
  tsunamis in the, 226
Particle rotation
  and magnetic relaxation of ferrofluid, 439
Peclet number
  and solute transport, 200
  and viscous fingering, 289–90, 292, 294–95, 297–98, 300, 306
"Phase plane" theory
  see Critical-point concepts
Photography
  high-speed
    and bubble-boundary interaction experiments, 102, 104
Poincaré-Bendixson theorem, 126–27
Point-vortex eddy models, 499–508, 527
Point-vortex solutions
  and eddy models, 513
Poiseuille flow
  and spectral methods, 353, 355
Poisson equation(s)
  and spectral methods, 357
  and turbulent premixed flames, 262–63
Polymer melts, 170
Polymer processing
  and viscoelastic entry flows, 180
Polymer solutions
  in tubular entry flows, 170–71
Porous media
  immiscible displacements in, 301–8
  miscible displacements in, 296–301
  and viscous fingering, 271–308
Power-law behavior, 163
Power-law fluids, 164–65
  and entry flows, 158, 164
Power-law index, 163, 166, 169
Prandtl, Ludwig, 1–21
Prandtl number
  and thermocapillary instabilities, 406
  and turbulent premixed flames, 245
Precipitation
  and supercell thunderstorms, 370–71, 374, 376, 389
Printing
  impactless, 451
Probabilistic field theories
  of turbulent premixed combustion, 238–39, 266
Probability density function
  and turbulent premixed flames, 238, 253–56, 258–61, 266
Propeller blades
  of fast steamships
    and cavitation bubbles, 100

R

Radial source flow
  and viscous fingering, 274, 281–82, 288, 294–95
Rankine-Hugoniot conditions
  and shock computation, 316, 320, 335
Ranque-Hilsch tube, 46–49
Rapid-distortion theory, 531–69
  and the dissipation transport equation, 557–59
  and distorted-structure modeling, 540–47
  and eddy-viscosity models, 549–56, 569
  future developments, 566–69
  pressure-strain closure, 559–66
  and Reynolds-stress transport modeling, 547–49
  and transport-equation modeling, 547–66
Rarefaction
  in multilayer flow, 86
  in single-layer flow, 78, 80
  in a two-layer flow, 82–83
Rayleigh-Bénard flow
  simulation of
    and spectral methods, 361
Rayleigh implosion mechanism, 104, 108, 121
Rayleigh number(s)
  and magnetic fluids, 455
  and thermocapillary instabilities, 406, 409, 417–18
Rayleigh solution
  in cavitation bubble models, 104–5
Rayleigh wave
  and tsunamis, 232–33
"Reaction-sheet" regime
  see Flame-sheet regime
Rectilinear displacements
  and viscous fingering, 274, 280, 295, 307–8
Reynolds number(s)
  and confined-vortices flows, 28–31
  and elastic fluid entry flows, 158, 160, 162, 164, 166–67, 170
  and flow patterns, 150, 152–53
  high
    and flow past a bluff obstacle, 387
    the Orr-Sommerfeld equation at, 285, 306
    turbulent flows at, 298
    wakes at, 148
  and impulsively started jets, 127
  infinite
    and a three-dimensional shear layer, 55
  and Kármán swirling flows, 466–68, 479–83, 485–87
  moderate
    jets and wakes at, 140–48
  and rapid-distortion theory, 533, 551, 561
  and shock computation, 314–15
  and spectral methods, 354, 358
  and thermocapillary instabilities, 406, 427
  and turbulent premixed flames, 244–46, 249, 251–53, 257, 259
Reynolds-number flows
  large
    and upstream blocking, 75
Reynolds-shear stress
  and rapid-distortion theory, 550
Reynolds-stress component(s)
  and rapid-distortion theory, 534, 553
Reynolds-stress distributions
  and rapid-distortion theory, 551
Reynolds-stress equations, 539, 547
Reynolds-stress model(s), 60–62, 65
  and rapid-distortion theory, 547–49, 556, 558, 561
Reynolds-stress transport
  equations, 59–60, 69, 71, 532
  models, 62, 68

and pressure-strain terms, 559–66
Reynolds stresses
and rapid-distortion theory, 533, 539–40, 548–49, 555, 559
and streamwise mean vorticity, 54
and turbulent secondary flows, 58–61, 64–67, 69–70
Riemann problem
and shock computation, 319–21, 325–26
Riemann solvers
and shock computation, 319–20, 326, 334–35
Rod-climbing effect, 168
Rossby force
and isolated eddy models, 510, 513
Rossby waves
and isolated eddy models, 495–96, 500, 510, 523–24
Rotary-shaft seal
magnetic-fluid, 445–46
Rotation
low-level
and supercell thunderstorms, 372, 393, 395–96, 398–99
and supercell thunderstorms, 371, 373–74, 399
and supercell thunderstorm propagation, 396–98
Rotationally induced thunderstorm propagation, 388–90
Run-up
of tsunamis, 229–30, 234

S

Saddle-node combination theorem, 132, 148
Saffman-Taylor instability, 276–77
Saffman-Taylor stability, 457
Seismic center
and tsunami excitation, 231–34
Separatrices
in flow patterns, 139
Sewage systems
and vortex valves, 36–37
Shear
mean
and turbulent vorticity, 535–36, 538
Shear flow
and thermocapillarity, 405
Shear-flow structure
and rapid-distortion theory, 533–34
Shear flows
and rapid-distortion theory, 534–43, 546, 552
Shear layers
boundaries of three-dimensional, 53
Shear-stress transport, 549–51
Shear thinning
and entry flows, 170–71
Shear-thinning fluid(s)
and entry flows, 162–68, 178
inelastic, 159
Shear-thinning viscosity
elasticity in the absence of, 172–78
and entry flows, 169
Shielding
and viscous fingering, 272, 279, 282, 284, 286–88, 292, 295, 297, 300
Shock
circulation
and Kármán swirling flows, 472, 478–79
normal, 322–24
Shock capturing, 314–16, 320, 324–26, 328, 333
Shock-capturing spectral methods, 351
Shock computation, 313–35
and airfoil problems, 327–29
characteristic-based schemes, 318–22
and λ-scheme, 321–22, 324–28, 330, 333–35
and monotonicity and second-order schemes, 320–21
MUSCL and PPM schemes, 321
one-dimensional studies, 318–25
and Riemann solvers, 319–20, 326, 334–35
two-dimensional problems, 325–33
Shock fitting, 314–18, 322, 328–29, 332–35
and spectral methods, 351, 362
Shock wave(s)
near the critical point, 577–78
rarefaction, 582–83, 585–87, 591–93, 595–98
and spectral methods, 350–51, 361–62
in a supercritical state, 581
in van der Waals gas, 593–97
Similarity
statistical hypothesis of and critical fluctuations, 578–79
Sink-float separation
and magnetic fluids, 448–49
Skew-induced secondary flows, 54, 56–64
Solute transport
field test and theory, 209–12
by groundwater, 183–214
stochastic theory of, 188–95
Sound waves
velocity and absorption of, 579–81
Spectral collocation, 340–41
Spectral/finite-difference methods, 360–61
Spectral Galerkin methods, 340–41, 355
Spectral methods, 339–62
and boundary layers, 346, 351–53
Chebyshev, 344–46, 351, 355, 361–62
Fourier, 345–46, 350, 353–54, 360–61
and homogeneous turbulence, 354–55
and inhomogeneous turbulence, 358–59
and inviscid flow, 349–51
and linear stability, 355–56
multidomain techniques, 348–49, 353, 360, 362
multigrid, 347–50, 357, 362
and Navier-Stokes flow, 353–61
and reacting flows, 361–62
and transition to turbulence, 356–58
Splitting
and viscous fingering, 272, 279, 286–87, 292, 295, 302
see also Tip-splitting instability
Spreading
and viscous fingering, 272, 279, 286–87, 292, 295, 297, 300, 304
Stability theory
linear, 408–11
Statistical model
of solute transport, 212–14
Stieltjes-Fourier integrals
and solute transport, 190–91
Stochastic modeling
of groundwater flow, 185
Stochastic theory
of solute transport, 188–95
Strain fields
and rapid-distortion theory, 537–38
Stratification
and isolated eddy models, 504–5

Stratified aquifer
and solute transport, 192–95, 206
Stratified eddy solution, 517–19
Stratified flow(s)
of finite depth
and upstream blocking, 87–91
of infinite depth
and upstream blocking, 91–96
upstream blocking in, 75–77
Stratified formation
and solute transport, 196–97, 199–200
Stress-induced secondary flows, 54–55, 70–71
Stress-relaxation phenomenon, 168
Stress-transport equations, 532
see also Reynolds-stress transport
Supercell thunderstorms, 370–99
anticyclonically rotating, 379–80
cyclonically rotating, 372, 379–85
and gravity waves, 390–92
propagation, 385–93
rotationally induced propagation of, 388–90
splitting of, 372, 374–79, 381, 383, 385, 389, 392
transition to tornadic phase, 393–99
Superparamagnetism
extrinsic
and ferrofluid, 440
intrinsic
and ferrofluid, 439–40
Surface-wave instabilities, 426–27
linear flow, 429–32
return flow, 427–28
Swirl-stabilized combustion, 32–35
Swirling flows
von Kármán, 465–88

T

Taylor-Couette flow
and spectral methods, 353, 356, 358, 360
Taylor-Goldstein equation
and convective storms, 391
Taylor short-time limit
and solute transport, 199, 201–2
Technische Hochschule (TH), 2, 3
Tectonic processes
and tsunamis, 231–34
Thermal conductivity
and magnetic fluids, 459–60
Thermocapillary instabilities, 403–33
and bifurcation theory, 412–16, 418
one-layer model, 404–7, 413
Thermochemistry
of a premixed flame, 240
and turbulent premixed flames, 245
Thermodynamics
law of corresponding states in, 578
of a substance in a critical state, 577–84
Thunderstorms
supercell, 370–99
early development, 373–74
splitting, 372, 374–79, 381, 383, 385, 389, 392
tornadic, 369–99
Tip splitting
and viscous fingering, 294–95, 297–98, 300
Tip-splitting instability
and viscous fingering, 285–87, 292
Tollmien-Schlichting waves
in channel flow, 356
Tornadic thunderstorms, 369–99
Transport equation
dissipation
and rapid-distortion theory, 557–59
see also Reynolds-stress transport equations; Stress-transport equations
Transport-equation models, 538
and rapid-distortion theory, 531, 533–34, 547–66
Troposphere
and supercell thunderstorms, 369–70
Tsunamis, 217–34
development
three stages of, 217
direction of, 233–34
equations for, 218–22
and linear theory, 222–24
numerical models of, 226–29
and the ocean bottom, 231–33
and a sloping beach, 229–31
and trapped waves, 224–26
Turbines
hydraulic
and draft-tube surge, 44–46
Turbomachine outlets, 37–41
Turbomachinery
cavitation in, 99–100
Turbulence
and combustion
in turbulent premixed flames, 259–66
homogeneous
and spectral methods, 354–55
inhomogeneous
and spectral methods, 358–59
of premixed flames, 243–45
transition to
and spectral methods, 356–58
Turbulence modeling
and rapid-distortion theory, 532–35
Turbulent premixed flames, 237–67
structure, 245–59
Turbulent secondary flows, 53–72

U

Ultrasound
at the critical point, 579
Upstream blocking, 75–96
in continuously stratified flow
finite depth, 87–91
infinite depth, 91–96
in multilayer systems, 86–87
in a single-layer system, 78–81
in two-layer systems, 81–85
Ursell number
and tsunamis, 229

V

van der Waals equation, 584, 594, 597
for a real gas, 577
van der Waals gas
shock waves in, 593–97
Viscoelastic flows
through contractions, 157–80
Viscosity
and critical points, 128, 134, 138
eddy-viscosity models
and rapid-distortion theory, 549–56, 569
kinematic
and flame sheets, 252
and Kármán swirling flows, 466
and spectral methods, 351–53
of magnetized fluid in plane shear, 459
near the critical point, 579
of Newtonian fluids, 158
and rarefaction waves, 595

and shear-rate dependence, 162–64
shear-thinning
absence of, 172–78
and shock computation, 314–15, 328, 330, 334
and spectral methods, 351
and thermocapillary instabilities, 405
and turbulent premixed flames, 259
vortex
and ferrofluids, 443
Viscous fingering
buoyancy-driven, 292, 295
and Hele-Shaw flows, 277–96
mechanisms of, 275–76
in porous media, 271–308
Volcanic activity
waves caused by, 217
von Kármán, Theodore, 465
von Kármán similarity principle, 465–66
Vortex
secondary-flow
and entry flows, 158, 161–62, 166–67
Vortex amplifiers, 35–37
Vortex enhancement, 168
Vortex flows, 64–69
in combustion chambers, 32–35
Vortex loop
and rapid-distortion theory, 536
Vortex valve, 35–37
Vortex-valve effect
and supercell thunderstorm propagation, 396
Vortices
confined
basic aspects, 28–32
and cyclone separators, 41–43
and draft-tube surge, 44–46
in flow machinery, 27–49
and the Ranque-Hilsch tube, 46–49
and turbomachine outlets, 37–41
vortex amplifiers, 35–37
vortex breakdown, 30–31
embedded, 67–68
isolated, 65
Taylor-Görtler, 28
Vorticity
anticyclonic
in tornadic thunderstorms, 383
longitudinal mean
turbulent flows with, 53–72
streamwise
skew-induced, 53–55
stress-induced, 54–55
and supercell thunderstorms, 373–74, 377–79, 383, 385, 393, 396–99
turbulent
and mean shear, 535–36, 538

W

Wakes
eddy motions in, 140–48
flow patterns in, 135, 137
at high Reynolds numbers, 148
nonmoving critical points in, 139
three-dimensional, 64
Wave-CISK
and supercell thunderstorm propagation, 391–92
Wave model
linear
and tsunamis, 224
Wave number(s)
imaginary
and eddy models, 497–98
and rapid-distortion theory, 532–34, 543
and viscous fingering, 280–82, 290–91, 294, 306
Wave phenomenon
in upstream blocking, 75
Waves
expansion and compression
and shock computation, 320
finite-amplitude
near the critical point, 577–87
gravity
and supercell thunderstorms, 390–92
and thermocapillary instabilities, 410
and tsunamis, 224–25, 232
long
and isolated eddy models, 498
run-up of, 229–30
and thermocapillary instabilities, 409–10
and tsunamis, 233
and viscous fingering, 280
marine gravitational
and tsunamis, 218
plane
and thermodynamic critical-point experiments, 589
and tsunamis, 220–21
rarefaction
in liquid and gas-liquid media, 577
resonance
and tsunamis, 231–32
Rossby
and isolated eddy models, 495–96, 500, 510, 523–24
short
and tsunamis, 233
and viscous fingering, 281
sound
as shocks, 319
space
and tsunamis, 231
Tollmien-Schlichting
in channel flow, 356
trapped
and tsunamis, 224–26
see also Tsunamis
Weissenberg effect, 168
Weissenberg number, 177
and elastic fluids, 169
and entry flows, 171, 177–78, 180
Whistling
vortex, 47–48
Wind field
and supercell thunderstorms, 370, 372, 377, 398
Wind shear
and supercell thunderstorms, 374, 376, 378, 381–85, 387, 392, 395
Winds
environmental
and supercell thunderstorms, 370, 386
mean
and supercell thunderstorms, 369–71, 373, 385, 388
and supercell thunderstorms, 370, 372, 383, 385

Y

Young-Laplace equation
and magnetic fluids, 451

Z

Zeitschrift für Angewandte Mathematik und Mechanik (ZAMM), 8–10
Zonal modeling
and rapid-distortion theory, 552–55